End of Chapter Checklist

You should now be able to:

- ✓ know that the reactivity series lists elements (mainly metals) in order of decreasing reactivity, and know the positions of the elements in the list at the beginning of this chapter
- ✓ understand the term 'displacement reaction'
- ✓ describe some simple reactions involving metals with metal oxides, salt solutions, water/steam and dilute acids
- ✓ understand the terms oxidation, reduction and redox in terms of both oxygen transfer and electron transfer
- ✓ understand how to work out simple ionic equations, omitting spectator ions
- ✓ make simple predictions about the reactions of a metal from its position in the reactivity series.

Questions

1 *a)* List the following metals in order of decreasing reactivity: aluminium, copper, iron, sodium.

b) Some magnesium powder was mixed with some copper(II) oxide and heated strongly. There was a vigorous reaction, producing a lot of sparks and a bright flash of light.

(i) Name the products of the reaction.

(ii) Write a balanced symbol equation for the reaction.

(iii) Which substance in the reaction has been reduced?

(iv) Which substance is the oxidising agent?

c) If a mixture of zinc powder and cobalt(II) oxide is heated, the following reaction occurs:

$Zn(s) + CoO(s) \rightarrow ZnO(s) + Co(s)$

(i) Which metal is higher in the reactivity series?

(ii) The zinc can be described as a reducing agent. Using this example, explain what is meant by the term 'reducing agent'.

(iii) Which substance in this reaction has been oxidised?

d) Aluminium, chromium and manganese are all moderately reactive metals. (Care! We are talking about manganese, **not** magnesium.) Use the following information to arrange them in the correct reactivity series order, starting with the most reactive one.

- Chromium is manufactured by heating chromium(III) oxide with aluminium.
- If manganese is heated with aluminium oxide there is no reaction.
- If manganese is heated with chromium(III) oxide, chromium is produced.

2 Study the following equations and, in each case, decide whether the substance in **bold type** has been oxidised or reduced. Explain your choice in terms of either oxygen transfer or electron transfer as appropriate.

a) $\mathbf{Zn(s)} + CuO(s) \rightarrow ZnO(s) + Cu(s)$

b) $\mathbf{Fe_2O_3(s)} + 3C(s) \rightarrow 2Fe(s) + 3CO(g)$

c) $\mathbf{Mg(s)} + Zn^{2+}(s) \rightarrow Mg^{2+}(s) + Zn(s)$

d) $Zn(s) + \mathbf{Cu^{2+}(aq)} \rightarrow Zn^{2+}(aq) + Cu(s)$

3 The equation for the reaction when solid magnesium and solid lead(II) oxide are heated together is:

$Mg(s) + PbO(s) \rightarrow MgO(s) + Pb(s)$

a) What does this tell you about the position of lead in the reactivity series? Explain your answer.

b) Rewrite the equation as an ionic equation.

4 Some iron filings were shaken with some copper(II) sulfate solution. The ionic equation for the reaction is:

$Fe(s) + Cu^{2+}(aq) \rightarrow Fe^{2+}(aq) + Cu(s)$

a) Write down any one change that you would observe during this reaction.

b) Which substance has been oxidised in this reaction?

c) Write down the full (not ionic) equation for this reaction.

5 Some experiments were carried out to place the metals copper, nickel and silver in reactivity series order.

Experiment 1: a piece of copper was placed in some green nickel(II) sulfate solution. There was no change to either the copper or the solution.

Experiment 2: a coil of copper wire was suspended in some silver nitrate solution. A furry grey growth appeared on the copper wire, out of which grew spiky silvery crystals. The solution gradually turned from colourless to blue.

a) Use this information to place copper, nickel and silver in reactivity series order, starting with the most reactive one.

b) In another experiment, a piece of nickel was placed in some copper(II) sulfate solution.

(i) Write down any one change that you would observe during this reaction.

(ii) Write the full balanced equation for this reaction. (Assume that nickel(II) sulfate solution is formed.)

(iii) Write the ionic equation for this reaction, and use it to explain which substance has been oxidised during the reaction.

6 *a)* Look carefully at the following equations and then decide what you can say about the position of the metal X in the reactivity series. Explain your reasoning.

$X(s) + 2HCl(aq) \rightarrow XCl_2(aq) + H_2(g)$

$X(s) + CuSO_4(aq) \rightarrow XSO_4(aq) + Cu(s)$

$X(s) + FeSO_4(aq)$: no reaction

b) Decide whether X will react with the following substances. If it will react, write down the names of the products.

(i) silver nitrate solution, (ii) zinc oxide, (iii) cold water, (iv) copper(II) chloride solution, (v) dilute sulfuric acid.

7 If you add some powdered aluminium to a small amount of cold dilute hydrochloric acid in a boiling tube, very little happens. If you warm this gently, it starts to fizz very rapidly.

a) Name the gas given off to produce the fizzing.

b) If you used an excess of hydrochloric acid, you would end up with a colourless solution. Name the solution.

c) Write the full balanced equation for the reaction.

d) Explain why the aluminium hardly reacts at all with the dilute acid in the cold, but reacts vigorously after even gentle heating.

8 Given some small bits of the metal titanium, and any simple apparatus that you might need, describe how you would find out the approximate position of titanium in the reactivity series using only water and dilute hydrochloric acid You need only find out that the reactivity is 'similar to iron' or 'similar to magnesium' or whatever. Your experiments should be done in an order that guarantees maximum safety. For example, if its reactivity turned out to be similar to potassium, dropping it into dilute hydrochloric acid wouldn't be a good idea!